Jan. 14, 1930. F. G. ARKELL 1,743,749

ELECTRORESPONSIVE DEVICE

Filed Jan. 11, 1929

Fig. 1.

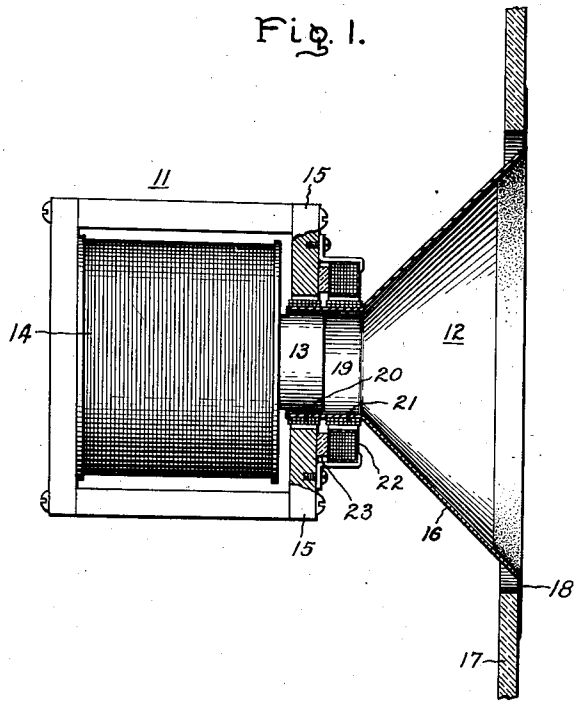


Fig. 2.

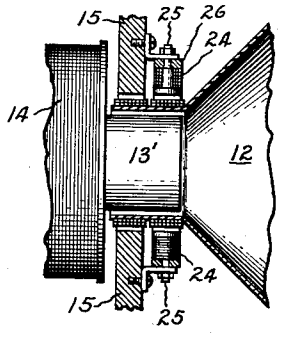
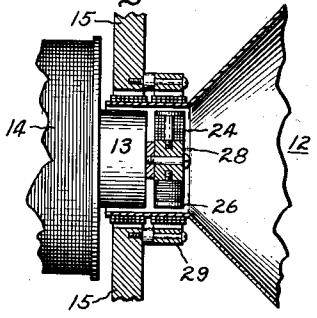


Fig. 3.



Inventor
Frederick G. Arkell,
by Charles E. Mullen
His Attorney.

Patented Jan. 14, 1930 1,743,749

UNITED STATES PATENT OFFICE

FREDERICK G. ARKELL, OF CLAPHAM COMMON, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

ELECTRORESPONSIVE DEVICE

Application filed January 11, 1929, Serial No. 331,752, and in Great Britain January 25, 1928.

My invention relates to devices for the interconversion of sound waves and electrical oscillations, of the kind including a diaphragm movable together with an annular coil located in a magnetic field, for example, electro-dynamic or moving-coil loud-speakers which, as is well understood in the art, may be arranged to operate as transmitters to generate electrical oscillations corresponding to received sound waves. According to my invention the moving-coil is a closed coil which can be inductively fed from a fixed coil.

The invention is especially applicable to loud-speakers of the kind having a cone- or frustum-shaped diaphragm, and according to one particular aspect it includes the combination of such a diaphragm with an annular coil closed on itself and secured to the diaphragm.

An arrangement according to the invention involves a moving-coil, cone-type loud-speaker in which the coil, carried at the inner end of the diaphragm, is closed on itself and arranged in inductive relation to a fixed coil to which oscillating current can be supplied when the loud-speaker is to operate.

A further feature according to the invention, as applied to a moving-coil, cone-type loud-speaker, involves mounting a fixed annular coil on the outer pole-piece of the magnetic structure, the inside of the coil being substantially flush with the face of the pole-piece, and arranging for the moving coil to extend not only into the annular air-gap of the magnetic circuit, but also within the fixed coil. Furthermore, in this case the impedance of the fixed coil is preferably arranged to be of a value such as will allow of the coil being directly coupled to the output valve. The inner pole-piece of the magnetic structure may be arranged to extend partly or fully within the fixed coil. Conveniently, the moving coil comprises two sections connected in series, one to lie within the outer pole-piece and the other within the fixed coil. In this case this latter section only will be inductively related to the fixed coil.

Instead of the fixed coil being an annular coil an equivalent arrangement such as an annular core with inwardly extending pole-pieces each adapted to carry a winding may be used. In this case, if the central pole-piece extends within this annular pole-piece a good magnetic circuit is provided for that part of the moving coil which is arranged to be inductively influenced. In an equivalent arrangement a core including outwardly extending pole-pieces with windings thereon forming the fixed coil is located at the end of the inner pole-piece, and a closed ring core or the equivalent is arranged on the main outer pole-piece of the magnetic structure to complete the magnetic circuit of the transformer comprising the fixed coil and a portion of the moving coil.

By inductively feeding the moving coil in the manner outlined there is no necessity for the more usual flexible connection to the moving coil, which is known to be a source of trouble, to be used. Moreover, the ratio of the turns of the fixed and moving coils, or of the inductively-related parts thereof, may be chosen so that the usual coupling-transformer by which the ordinary moving-coil loud-speaker is supplied can be omitted.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

In the drawing Fig. 1 illustrates a conventional electro-dynamic moving coil cone type loud speaker equipped, in accordance with my invention, with a moving coil closed upon itself and inductively related to a fixed coil; Figs. 2 and 3 show modifications of my invention.

Referring to the drawing in detail, Fig. 1 illustrates a loud speaker including an electro-magnet 11 and a conical diaphragm 12 arranged to cooperate therewith. The electro-magnet 11 includes a core 13 upon which a coil 14 is wound, and pole pieces 15. The diaphragm 12 includes a truncated cone member 16 attached at its larger end to a frame 17 by means of a flexible member 18, and a cylindrical member 19, attached to the smaller end of member 16 upon which a short-circuited winding, consisting of two series connected coils 20 and 21, is mounted. The

diaphragm and magnetic structure are so arranged that coil 20 projects into and is centered in respect to the air gap between the pole pieces 15 and the coil 13. The coil 21 is located outside of the air gap and is surrounded by a fixed coil 22 supported by the electro-magnet 11 and spaced therefrom by a spacing ring 23.

Fig. 2 illustrates a modification of my invention in which a core piece 13′ extends partly or fully within the fixed coils. In this case the fixed coil instead of being an annular coil, such as coil 22 in Fig. 1, comprises coils 24 wound upon inwardly extending pole pieces 25 which are mounted on an annular magnetic member 26.

Fig. 3 illustrates still another modification of my invention in which the coils 24 are wound on outwardly extending pole pieces 26 mounted upon a member 28 which is attached to the end of core 13. An annular magnetic member 29 attached to pole pieces 15 and whose inner diameter is flush with the outside diameter of the air gap, completes the magnetic circuit for the fixed coils 24.

The coil 22 or coils 24 are supplied with oscillating currents when it is desired to operate the loud speaker and may be designed with such impedance and transformation ratios that the coupling transformer through which the loud speakers are usually connected, may be omitted.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An electro-responsive device including a vibratable member, means for producing constant and variable magnetic fields in different planes, a short-circuited winding mounted upon said vibratable member and comprising a plurality of series connected connected in series. Hence when the arm 14 constant magnetic field and another coil arranged in said variable magnetic field.

2. A sound producing device including a diaphragm, an electromagnet arranged to produce a constant magnetic field, an input winding adapted to create a variable magnetic field, a short-circuited winding attached to said diaphragm and provided with a plurality of series connected coils, one of said coils being arranged in said constant magnetic field and another coil being arranged in said variable field.

3. An electro-responsive device including a vibratable member, means for producing a constant magnetic field, a short-circuited winding mounted upon said vibratable member comprising a plurality of series connected coils, one of said coils being arranged in said constant magnetic field, and a fixed primary winding inductively related to another of said coils.

4. An electro-responsive device including a vibratable member, means for producing a constant magnetic field, an input transformer including a fixed primary winding and a secondary winding mounted on said vibratable member, a coil mounted in said magnetic field and connected in series with said secondary winding.

5. A sound producing device including a vibratable diaphragm, means for producing a constant magnetic field, an input transformer including a fixed primary winding, a magnetic structure arranged to support said primary winding, a secondary winding mounted on said diaphragm and a coil mounted in said magnetic field and connected in series with said secondary winding.

In testimony whereof I have hereunto set my hand this 27th day of December, 1928.

FREDERICK G. ARKELL.

CERTIFICATE OF CORRECTION.

Patent No. 1,743,749. Granted January 14, 1930, to

FREDERICK G. ARKELL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 41, claim 1, strike out the words "connected in series. Hence when the arm 14" and insert "coils, one of said coils being arranged in said"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of February, A. D. 1930.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)